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Lubrication

A Technical Publication Devoted to the Selection and Use of Lubricants

THIS ISSUE

PUBLISHED BY
THE TEXAS COMPANY
TEXACO PETROLEUM PRODUCTS

TEXACO LUBRICANTS
IN MODERN CANNERY SERVICE

CONVEYORS, ELEVATORS AND LINE SHAFTING

Plain Bearings	
Oil Lubricated	TEXACO ALEPH OR ALTAIR OIL
Grease Lubricated	TEXACO STAR GREASES OR TEXACO MARFAKS
Ball or Roller Bearings	
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For Heavy Duty	TEXACO MARFAKS
Oil Lubricated	TEXACO REGAL OIL B, OR TEXACO CETUS OIL

POWER TRANSMISSION MACHINERY

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(*Grease Lubricated*)	TEXACO STARFAK GREASE NO. 2, OR TEXACO MARFAK NO. 2
Built-in Gears	TEXACO ALTAIR OR ARIES OIL, OR TEXACO MARFAK NO. 1
Gears	
Worm Drives	TEXACO LEADER CYLINDER OIL
Bevel Gears—(*Enclosed*)	TEXACO ARIES OR ARCTURUS OIL
(*Exposed*)	TEXACO CRATER COMPOUND NO. 1
Chains	
Silent Chain Drives	TEXACO TEXOL E OR ALTAIR OIL
Exposed Installations	TEXACO CRATER COMPOUND B OR NO. 00

POWER PLANT

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Cylinders	TEXACO CETUS, ALCAID OIL OR TEXACO REGAL OIL C
Bearings (*External*)	TEXACO NABOB OR ALEPH OIL
Crankcase Service	SAME OIL AS IN CYLINDERS
Steam Cylinders	
Low Pressure Service	TEXACO DRACO CYLINDER OIL
Medium Pressure Service	TEXACO PINNACLE CYLINDER OIL
Bearings (*External*)	TEXACO NABOB OR ALEPH OIL
(*Enclosed*)	TEXACO REGAL OIL B OR C
Bearings—(*Grease Lubricated*)	TEXACO CUP GREASE NO. 1 OR NO. 3

CANNING MACHINERY

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Ball or Roller Type	
(*Light to Medium Duty*)	TEXACO STARFAK GREASE NO. 2
(*Heavy Duty*)	TEXACO MARFAK NO. 2
Circulating Systems	TEXACO ALGOL OIL
Gearing	
Exposed to Water or Acids	TEXACO MARINE ENGINE OIL A OR TEXACO DOLPHIN MARINE ENGINE OIL
Enclosed (*Bath Lubricated*)	TEXACO ARIES OR ARCTURUS OIL
Pitman Shafts	TEXACO LEADER CYLINDER OIL

COOKING, CLOSING AND SEAMING EQUIPMENT

Bearings and Spindles	TEXACO STAR GREASES
Seamer Rolls	TEXACO MARFAKS
Top Driving Heads	TEXACO MARFAKS
Vacuum Valves	TEXACO URSA OIL HEAVY
Bearings, Air Valves and Enclosed Gears on Cookers	TEXACO MARINE ENGINE OIL A, OR TEXACO DOLPHIN MARINE ENGINE OIL
Driving Gears (*Exposed*)	TEXACO CRATER COMPOUND NO. 1 OR NO. 2
Vertical Bearings in Exhausters	TEXACO MARFAK NO. 3
Sprocket Spindles of Steam Boxes	TEXACO CAVIS MINERAL CYLINDER OIL, OR TEXACO THUBAN T

THE TEXAS COMPANY

Texaco Petroleum Products

135 East 42nd Street, New York City

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The Canning Industry

Lubrication of Essential Machinery

THE study of methods of food protection and preservation has attracted the attention of the Organic Chemist and the Mechanical Engineer to a marked degree over recent years. It has been accentuated equally by its relation to home economics and public health, and to mass production of a type of commodity adaptable to retail distribution. In this the Organic or Food Chemist has been compelled to develop means of preservation which will effectively prevent bacterial growth; the Mechanical Engineer in turn being confronted with the problem of designing machinery which will economically handle huge volumes of seasonal materials so rapidly and effectively as to keep the ultimate cost to the consumer in line with the cost of the raw products.

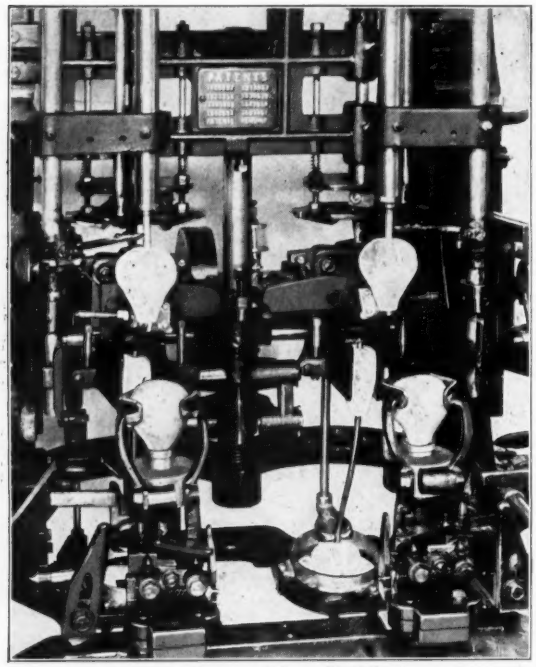
It has been an intriguing problem to all concerned, especially during a period of reorganization of industries, health campaigns, and price readjustments. The purity of the present day type of canned foods, the similarity in taste to the freshly cooked articles, and the uncanny productive ability of the machinery employed, are all tributes to the scientific minds which have been engaged in this work. It is gratifying furthermore to note that once again the Petroleum Industry has functioned in its studies of the lubricating requirements of the machinery involved, and to read of its cooperative research with the manufacturers in developing means of lubrication which will not only prevent contamination of the materials being handled, but will so protect all moving parts that maximum production can be maintained in the interest of low cost and a reasonble margin of profit. All this is highly essential due to the limited duration of the average canning season.

The machinery involved is extremely diverse inasmuch as it has had to be designed largely to accommodate the type of food-stuffs to be handled. The canning of fruits and vegetables, for example, requires sorting, paring and coring. Meats and fish in turn must be handled in an entirely different manner. All, however, require conveyors, refrigerating equipment, power generating and transmission machinery, cookers, exhausters, and the can closing machine which is the final step in the production process, with the exception of pasteurizing or sterilizing which immediately follows.

EFFECT OF ACID ON LUBRICATION

The process of fermentation which will so often take place where fruits or fruit juices are being handled will lead to formation of acetic acid. Citrus fruits, in turn, give rise to the presence of citric acid. Weak acid solutions may often have a more corrosive effect upon bearing materials and machine parts than the

more concentrated type. It becomes one of the primary functions of the lubricant to prevent these acid solutions from coming into direct contact with the bearing parts. This can be best accomplished if the lubricant is resistant to chemical reaction or oxidation, and if the parts



Courtesy of Coons Fruit Equipment Corporation

Fig. 1—The Coons Pear and Apple Machine which makes a finished product of either fruit. When handling pears they are fed to the centering and feeding element by an operator at the rate of 40 per minute. Each pear is peeled, cored, seed-celled and cut into halves or quarters, leaving the machine in the finished state ready for the can at the rate of one case in about every three minutes. Lubrication of the working elements of this machine must be very carefully studied, in the interest of protecting both the lubricant and the moving parts against the destructive action of the fruit juice.

to be lubricated are so designed as to insure that the lubricant cannot leak or be thrown out during operation.

It is important to remember that should acetic acid come in contact with the grease used for lubrication, it will have a tendency to decompose the soap constituent, leaving a mixture of fatty acid and mineral oil. In a ball or roller bearing this might lead to corrosion, and subsequent sludge formation.

In certain types of lubricating systems sludge formation may be highly objectionable due to the possibility of clogging and interference with complete circulation of the lubricant. In others, sludge formation may be the forerunner of gumming, especially where greases or compounded oils are exposed to acetic acid.

It is obvious, therefore, that in the lubrication of machinery parts which may be exposed to fruit juices and acids of fermentation, a policy of insisting on highly refined petroleum ingredients will be insurance against sludge development. By using petroleum oils resistant to the solvent action of acetic acid the stability of a grease is also more positively maintained and hence its resistance to penetration of acid to the metallic parts being lubricated.

Determination of Lubricating Ability

Lubricating ability is denoted by certain physical and chemical characteristics contingent upon the method of handling or application of the lubricant and the operating conditions. In canning service the latter must be given prior consideration; normally the most prevalent will involve a water or acid condition. In this connection the ability of a lubricant to protect the bearings, gears, or chains which may be so exposed will be indicated by its emulsibility, and its resistance to oxidation or break down. Where continued contact with water may prevail, the ability to emulsify and thereby form a lubricating film more resistant to the washing action of water is all-important. Elsewhere the demulsibility or ability to separate from water should be studied. Resistance to oxidation, which phenomenon may lead to oil separation and gum formation is in turn, highly important in a grease.

Emulsification and Demulsibility

Emulsification is aided by compounding with a fixed oil. In other words, when certain fixed oils or soaps are added to a mineral oil and the subsequent compound agitated with water the two liquids will separate very slowly, or they may remain mixed for an indefinite period. The more intimate the mixture, the better and more lasting will be the emulsion. Emulsification is essentially a physical phenomenon, as it is brought about between mineral oil plus a fatty component and water.

In view of the fact that there are practically no limiting conditions which will definitely determine whether there is a complete emulsion, as the transition from a solution to an emulsion is not sharp, it must be realized that in some cases an emulsion may exist and yet the resultant combination of certain oils plus water may appear to be a true solution due to the clearness.

Theory of Emulsification

The most generally accepted theory is that there is a balancing of physical and perhaps chemical forces at the surfaces between water and oil, so that there is no resulting tendency for the individual drops to either combine or become further subdivided. With oils which lend themselves to ready emulsification, the prevailing forces are of sufficient intensity to

prevent or at least so retard the action of gravity towards separation of liquids of different density, that they will remain in more or less permanent emulsion.

Some liquids, such as soluble oil, will emulsify with greater rapidity, the particles reaching their final balanced state of sub-division very quickly. Others must be mechanically or otherwise atomized, before they remain in permanent suspension with respect to water. Laboratory examinations of certain types of emulsions indicate that the particles are so small that they can only be observed under an ultra-microscope.

The ability of an oil to emulsify, is determined in the laboratory by agitation with water, and then noting the readiness with which separation of the resultant oil-water emulsion will occur. The object, of course, is to study the emulsifying tendency of the oil. There is, a distinct relation between emulsification, or the rate at which an emulsion will develop when an oil is agitated with water, and demulsibility, or the rate at which this emulsion will separate into its original components.

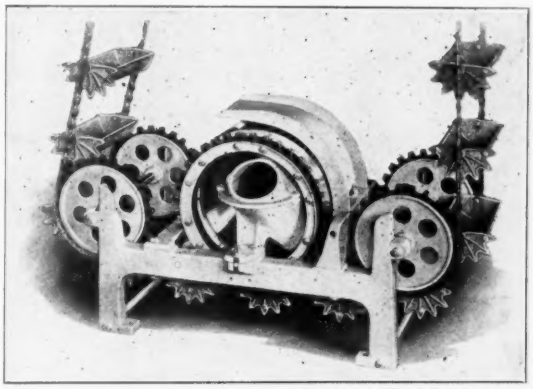
Saponification

Saponification, as the term is commonly used, is a chemical reaction having to do with the production of soaps by treatment of a fatty oil with certain types of alkaline solutions. It should be understood by all who have to do with selection of greases for ball or roller bearing service.

In studying the relation of saponification to canning machinery lubrication it is well to remember that one of the essential differences between fixed or fatty oils and mineral oils involves the ability or susceptibility of the former to undergo a simple chemical reaction whereby the original compounds are split up and their elements recombined chemically, generally with certain of the alkali group. Combinations of the larger portion of the fatty oil molecules with a metal in this manner are termed soaps, the reaction being known as saponification.

The more common soaps are produced by treatment of a fatty oil with caustic soda or potash. On the other hand, in the preparation of certain types of lubricants, it is also practicable to employ soaps containing lime (calcium), aluminum or lead. Although saponification is a characteristic which is normally foreign to petroleum or mineral oils, it should be understood that, dependent upon the source of these latter, there may be a very slight tendency toward this phenomenon. In general, however, soaps are produced directly from fixed oils or fats.

The chemistry of petroleum has indicated that the same result may be obtained by the action of an alkali upon a fatty acid derived from petroleum. The term saponification, therefore, may also be applied to the action of an alkali upon those acids of an organic nature



Courtesy of Link-Belt Company

Fig. 2—Showing an Hansen Sanitary Conveyor Boot for peas, beans and other types of seeds. This unit is manufactured by the Hansen Canning Machinery Corporation and is equipped with a Link-Belt Chain.

which may be produced in a slight degree in straight petroleum oils. The ability of fatty oils to produce soaps has been used to advantage in the development of means for determining the presence of such an oil and its approximate volume in a mixture of mineral and fatty oils.

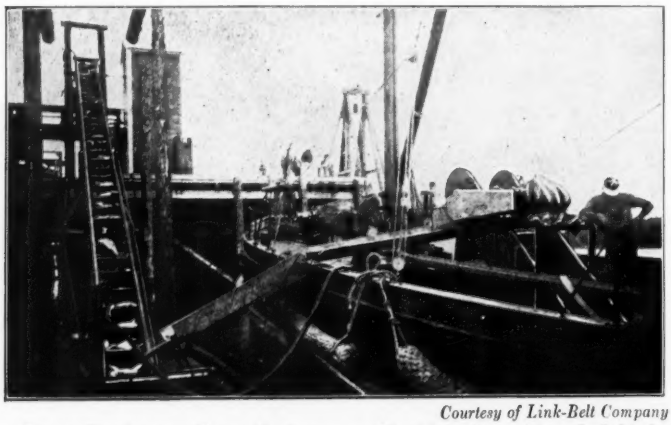
The test is commonly known as the determination of the saponification number. Most fixed or fatty oils will react with caustic soda or potash to approximately the same degree. In other words, the equivalent amounts of the former will neutralize the alkalinity of about the same amount of caustic. In order to express this effect in a comparative manner the unit has been taken as the number of milligrams of caustic potash that will react with or be neutralized by one gram of oil.

The saponification number of such products will range between 190 and 200. As a result, where an unknown product or lubricant is involved, by determining its saponification number a fair approximation can be made as to the amount of fatty oil contained. If the nature of this fatty oil is indicated by other tests the percentage can be determined more exactly, inasmuch as the saponification numbers of the various pure fixed oils employed by the petroleum industry are definitely known.

Acidity Neutralization

The potential acid characteristics of petroleum lubricants must be known wherever corrosion may be a factor, as for example in anti-friction bearing service. Acidity which

develops in use is undoubtedly detrimental, for it is almost invariably the prelude to sludging, gum formation and accumulation of corrosive deposits, especially where compounded oils or greases are used.



Courtesy of Link-Belt Company

Fig. 3—Showing a small portable elevator capable of being lowered into the hold of a cannery tender to elevate fish out of the ship and into the flight conveyor on the dock.

In discussing this under the subject "Neutralization," the A. S. T. M. states that: *"Practically all petroleum lubricating oils contain substances, of varied and indeterminate chemical composition, which have acid characteristics. The proportion of these substances present in an oil is commonly referred to as its 'organic acidity'. These acid compounds are, mainly, natural constituents of crude petroleum and their presence in finished lubricating oil is not necessarily an indication of improper refining or poor quality.

"A large proportion of the petroleum lubricating oils now produced undergo treatment with mineral acid and caustic alkali in the course of refining. If the refining operations are not properly conducted, small quantities of one or the other of these chemicals may remain in the finished oil and, of course, are undesirable and unnecessary impurities.

"The 'Neutralization Number' of an oil is defined as the weight in milligrams of potassium hydroxide required to neutralize one gram of oil. It represents the sum of the quantities of mineral and so-called organic acids present in the oil or the difference between the organic acidity and the alkali present in the oil. If, as is usually the case, no mineral acid or alkali is present in the oil, the neutralization number is directly proportional to 'organic acidity'."

The relation which acidity bears to emulsification and sludge formation has been the basis of considerable study on account of the extreme complexity of the acid-forming constituents such as sulfur and oxygen, and the limited knowledge of their reactional tendencies. Were these reactions known more positively, or could oils be so refined as to remove or more effectively neutralize their organic acid-forming constituents, the problem of corrosion might be materially simplified. As it is, effort can only be made in refinement to render oils as chemically stable as possible. But no process renders an oil entirely non-reactive when it is subjected to moisture and oxidizing conditions.

Oxidation and Gum Formation

Petroleum greases and mineral oils will be subjected to more or less oxidation when subjected to contact with water, especially under higher temperatures in the presence of air. These conditions are normally so involved and so contingent upon one another, however, that no one of them can be rightly claimed as being more detrimental than the other. On the whole, however, it may be stated that the extent to which any petroleum lubricant will resist oxidation depends largely upon the refinement of the original oil, for certain petroleum hydrocarbons tend to oxidize more readily than others.

Modern refinery practice, therefore, endeavors to remove these components by careful and accurate refining. The more reliable the manufacturer, naturally the more dependence can be placed on his methods of refining. Oxidation will, of course, occur in practically any oil if it is subjected to oxidizing conditions. In fact, wherever particles of air and water are suspended or retained within the body of an oil to form an emulsion, only a slight elevation of temperature during operation will be necessary to bring about an oxidizing reaction between the air and oil. As an adjunct to emulsification, oxidation may be said to have certain advantages. As the forerunner of sludge formation and development of acidity, however, it is a detriment.

CONVEYORS

The conveyor serves a variety of purposes in the modern cannery. It is used for moving raw foodstuffs from boat, truck, or box car in unloading operations; it handles the products in the course of production from cold storage rooms to the sorting tables, preparation machines and canning equipment; and carries the finished canned goods to the storage or shipping departments in many plants. In addition, sometimes the conveyor even becomes an integral part of a processing unit.

* The significance of Tests of Petroleum Products—Report of Committee D-2 of the A.S.T.M., Sept., 1934. P. 32.

Production methods and plant schedules have been markedly affected by the improvements which have been made in conveyor design; in particular, they have been rendered more dependable by the study which has been given to bearing design, housing seals and other means to protect lubrication. This study on the part of conveyor builders and the bearing industry has been largely prompted by appreciation of the rough service to which conveyors are so frequently subjected. Their rugged construction will enable many of such units to operate apparently irrespective of the care received, the loads applied, or the manner in which wearing parts are lubricated. Some operators even assume that they can neglect or abuse conveyors almost indefinitely, and still get the results desired. In the final analysis, however, lubrication and judicious maintenance must be properly carried out if costs of upkeep are to be reduced. This also has a direct relation to power consumption for operation of a conveyor requires power, and it is amazing how power consumption will increase if operating conditions are unfavorable and frictional resistance is allowed to build up. The designing engineer, however, has fully realized this fact to the end that in the future, power consumption and lubrication problems should be markedly decreased in modern cannery operation.

Friction between the bearing surfaces, rollers, chains, sprockets, and gearing, can never be entirely eliminated, consequently a certain amount of wear must always be expected. If this is allowed to continue, ultimately the conveyor must be cut out of service for repairs, to the detriment of production efficiency. Fortunately, friction and excessive wear can be reduced by effective lubrication, provided constructional details are correct and proper attention is given to periodic adjustment of the parts affected.

Conveyor Construction

In full realization of the prospective duty, conveyors are built for endurance and hard service. A number of types are adapted to cannery operations.

The screw type which is essentially a stamped or rolled steel spiral, secured by lugs to a pipe shaft, and the ribbon conveyor which consists of a ribbon flight similarly secured to the shaft, with an open space between the ribbon and shaft, are subject, probably, to the most severe service.

The screw, or as it is sometimes termed, "the spiral conveyor", is designed for horizontal moving of comparatively dry materials in contrast with the ribbon conveyor which is designed to handle damp, sticky materials which would otherwise build up around the shaft of a spiral conveyor. Another type of conveyor adapted to non-abrasive materials is the scraper or flight conveyor. It functions by dragging the product along a trough by means of flights which are usually made of wood.

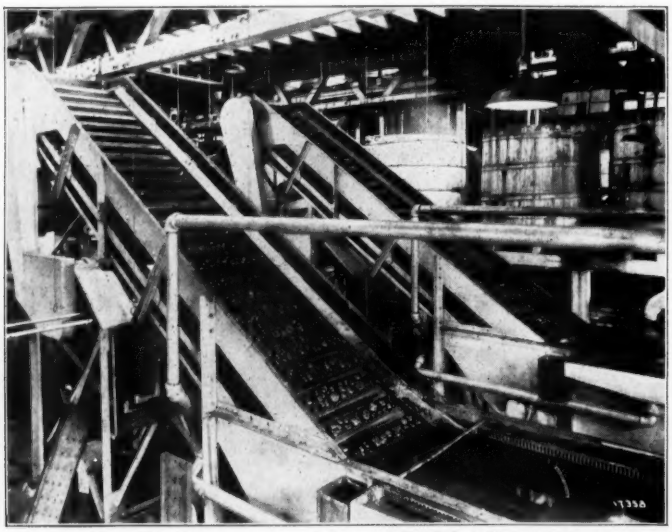
A scraper conveyor can be used either horizontally or on an incline. It is built with either a single or double chain to which are bolted the flights or scrapers. These flights scrape the material along the trough discharging through openings in the trough bottom which are governed by gates.

The bucket is another type of conveyor suited to bulk materials handling. It involves the use of bucket-shaped receptacles to take the place of flight or apron plates and it can be constructed therefore for vertical as well as horizontal service. Various types include open top, "V" bucket and pivot bucket carriers or elevators. Constructional features vary but

Courtesy of The Jeffrey Manufacturing Company

Fig. 4—A Jeffrey pivoted bucket carrier adapted to the handling of tomatoes. Note that in this type of operation it is essential to use porcelain-coated buckets. Lubrication is important in the handling of such products for all bearings in particular must be effectively protected against entry of juice and the resultant detrimental effects which the latter might have upon both lubricants or bearing surfaces. Pressure grease lubrication has been found to be helpful in this regard.

the principles are similar in all. These conveyors will handle practically any material which will not adhere to the containers. Bucket conveyors consist essentially of a pair of roller chains, a strand of chain or in some installations a belt, to which the buckets are attached. Either may be vertical or inclined and have continuous or non-continuous buckets. The discharge and in-take of any such conveyor will depend upon the locality and the materials to be handled.



Courtesy of The Jeffrey Manufacturing Company

Fig. 5—The apron-type conveyor is also adaptable to handling of tomatoes; in this connection being used to transport the product to the wash line.

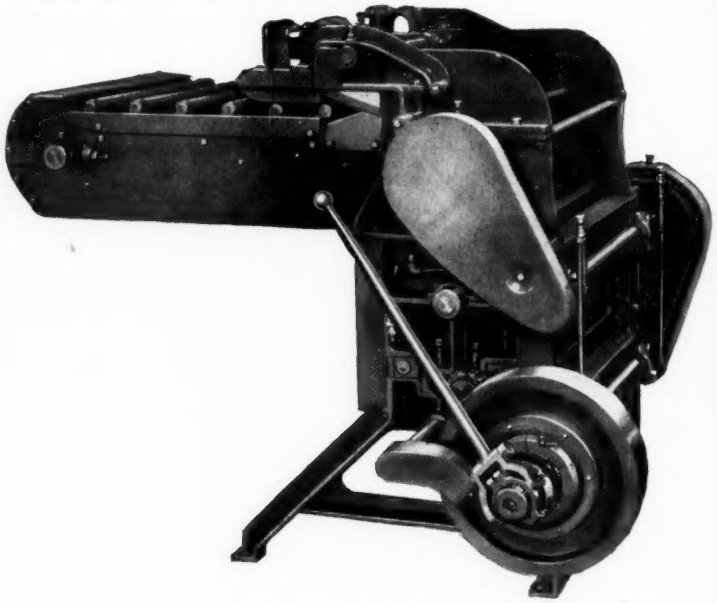
In contrast with the above there are the so called carrying types of conveyors known as the apron or belt machines. The apron conveyor is capable of handling any material which will not adhere to the carrying surface nor leak through the joints between the plates. It is built of two sets of roller chains separated by overlapping apron plates which form the carrying surface. These chains are driven by sprockets at one end, take-ups being provided at the other. This conveyor always pulls the material toward the driving end at which point discharge must be provided for.

Another adaptable type of conveyor to cannery service is the belt conveyor. It involves an endless belt of fabric designed to travel over pulleys at the conveyor ends and over anti-friction idlers located at suitable intervals between the two extremities. Such a conveyor will handle any materials in bulk which will not adhere to it, and which can be properly fed. It is also well suited for handling package goods. A distinct advantage is that it can be used for service at from eighteen to twenty degrees incline depending on the weight and adhesive qualities of the products, with marked absence of lubricant contamination of the products being handled.

REFRIGERATION MACHINERY

Refrigeration machinery is a most important adjunct to the preservation of foods prior to canning. Obviously it must be capable of always functioning effectively, otherwise serious retarding of entire plant procedure may result. Lubrication as the protecting element in this regard must, therefore, be always positive and dependable.

In this matter of lubrication one must consider not only the action and effects of the lubricants upon parts not requiring lubrication, but also the possible effect upon the actual wearing surfaces. The utmost care and judgment must, therefore, be used in selecting such lubricants, and studying the limitations of the various means of lubrica-



Courtesy of Sprague-Sells Corporation

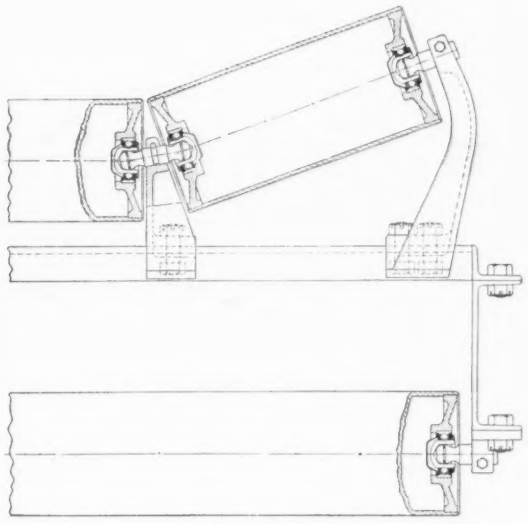
Fig. 6—Showing the Sprague-Sells Peerless Super Corn Husker. A feature of this device is that it requires practically no adjustment. All parts as far as possible are equipped for pressure grease lubrication. Here, as on other such machinery, every care must be given to choice of a lubricant which will effectively protect the bearing elements against entry of foreign matter.

tion which may be employed. Normally, these will employ the principles of splash or pressure application.

Pressure can be applied to the lubrication of both vertical and horizontal machines. Splash lubrication, however, is more adapted to the vertical compressor. The system involved for the lubrication of compressor cylinders, stuffing boxes and enclosed bearings will have a decided influence upon the grade of the oil that should be used.

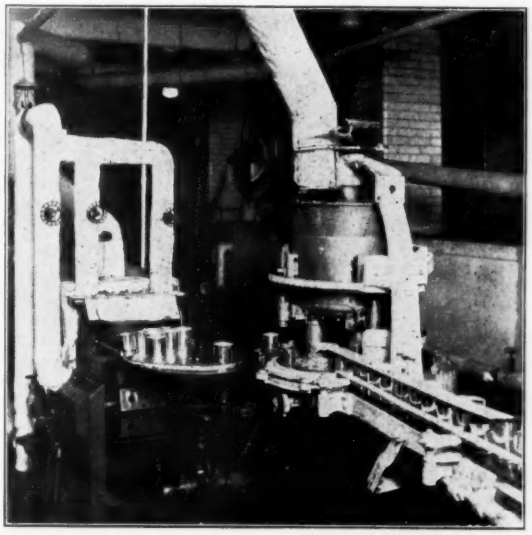
Splash Lubrication

In a system of this type oil is automatically circulated or splashed by the rotating crank, the level in the crankcase being maintained just high enough to permit this element to dip and splash a copious amount of oil to the cylinder walls and other contact surfaces. As the compressor continues to operate, the crankcase becomes filled with a lubricating vapor above the main body of oil. This in turn will insure added lubrication of all main, wrist-pin and crank-pin bearings. Good judgment must always be used in controlling the oil level, for if it becomes too high the oil may be churned by the crank, to bring about such violent agitation in the main body of oil as to preclude effective precipitation of any solid impurities that may be present. There is also the possibility of lubricant passing the piston rings, to enter the condensing and evaporating parts of the system, impose an added load on the oil separator or even interfere with refrigerating efficiency. This may be especially aggravating if the rings are not tight or where the oil may have a tendency to congeal at too high a temperature; hence the requirement for low pour test in refrigerating oils.



Courtesy of The New Departure Manufacturing Company

Fig. 7—Showing a type of conveyor roll bearing especially adapted to the food machinery industry. Design has been particularly studied from the viewpoint of preventing misalignment, binding or sliding of the belt. The bearings are permanently sealed which eliminates the necessity for re-lubrication.



Courtesy of Link-Belt Company

Fig. 8—A Link-Belt Equipped Can Conveyor in a meat packing plant. Note the can filling machine at the right. Chain lubrication on a unit of this type must be carefully manipulated to prevent excess lubricant from being thrown off to perhaps contaminate the product being handled.

Sludge Elimination

Excessive oil, in a splash lubricated system, will also involve the possibility of difficulty when draining and cleaning, especially where sludging has developed. Certain oils when splash agitated in a crankcase will give rise to sludge formation if they have not been highly refined. In part this is due to chemical reaction of ammonia with certain constituents of the oil, especially when certain types of synthetic ammonia are used. It will be most probable where water is present or the oil is laden with foreign matter, such as dirt, metallic particles or carbon.

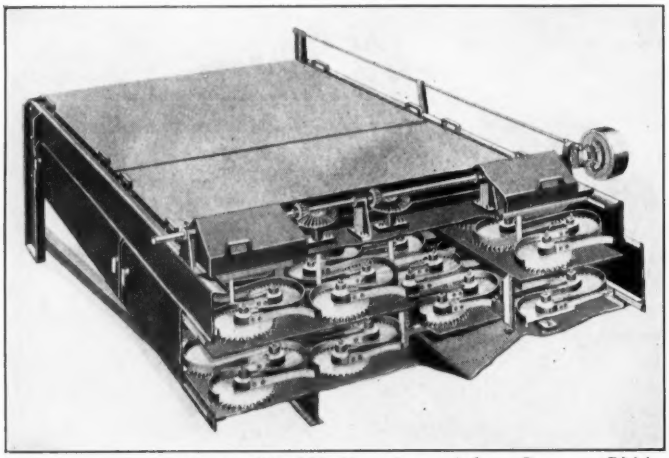
Regular periods for cleaning should be observed, therefore, with careful investigation of the condition of the used oil, for this will very often indicate both the approximate suitability of the latter and the extent to which effective lubrication is being accomplished.

Pressure Lubrication

Pressure lubrication in contrast with the splash method, controls accurately the amount of oil delivered to cylinder walls and compressor bearings. Such a system, however, will require more equipment, piping, etc., and frequent filling of the reservoir (where a mechanical force feed lubricator is involved) and more attention from the operator. On the other hand, pressure lubrication affords more

possibility of effective filtration or purification of the oil, especially where there is complete circulation and a suitable filter is employed.

The mechanical force feed lubricator is extensively used where compressor cylinders are to be pressure oiled. Excellent economy will be attained by regulating such lubricators so that just enough oil is delivered to maintain the requisite lubricating films, with drainoff reduced to a minimum.



Courtesy of Food Machinery Corp.—Anderson-Barngrover Division

Fig. 9—The exhauster is an interesting piece of equipment in cannery operations. Anderson-Barngrover have given particular attention to a type of design which will assure smooth, steady forward motion to prevent jaring of the cans and spilling of the contents. The above transverse section through the box shows an inclined disc run and drive. Pressure grease lubrication is extensively employed on this machine.

The mechanical force feed lubricator enables independent lubrication of the internal and external parts; in other words, using this device with perhaps three outlets for cylinder and stuffing box or oil lantern service, and an independent gravity or mechanical pressure circulating system for all other moving parts.

Selection of Compressor Oils

Choice of lubricants for refrigeration service requires due regard for the duty involved and the operating conditions that will probably be encountered. To overlook or to disregard the importance of such factors as the method of lubrication, the temperature in the expansion or refrigerating coils, the mechanical condition of the compressor, etc., and the location, type and efficiency of the oil separator may frequently lead to marked increase in maintenance costs and reduction in capacity as well as time lost due to shut-down.

In this regard pour test and viscosity require primary consideration, for it is these characteristics which will be indicative of the extent and degree of success with which any lubricant will function, in accordance with the particular operating and constructional conditions prevailing. It is obviously most important that an oil for refrigerating machinery lubrication shall remain fluid at the lowest temperatures to which it may be subjected during operation. These temperatures will be encountered beyond the expansion valve in the expansion or refrigerating side of the system. Many oils, of course, by virtue of their base and degree of refinement, will not be able to withstand lower temperatures without congealing to a certain extent, depending upon their wax content.

When this occurs it indicates that a film of oil will be deposited on the inner surfaces of the refrigerating piping, to form more or less of an insulating medium which will prevent proper abstraction of heat from the compartment or medium which is to be cooled. If this is allowed to continue, the refrigerating capacity of the system will be reduced and ultimately it will be necessary to clean out these congealed oil deposits, to bring back refrigerating efficiency.

The pour test essential to refrigeration service must, therefore, be sufficiently low to insure continued fluidity at the lowest temperatures prevalent in the evaporating side of the system. There should also be sufficient viscosity throughout the range of operating temperatures to enable the oil to serve at all times as an effective lubricant for the moving parts, as well as an adequate seal to prevent blow-by of gas past the piston rings.

A refrigerating compressor oil must also at all times be practically free from water, otherwise this latter may freeze if carried over to the refrigerator coils, in which case it would probably remain in the system and result in a certain decrease in evaporative efficiency and cooling capacity.

Inasmuch as canning operations will normally involve the ammonia type of compressor, straight mineral filtered oils having a viscosity of from 150 to 200 seconds Saybolt at 100 degrees Fahr., should be usually satisfactory where the temperature in the refrigerating coil is below 0 degrees Fahr. Above this temperature, however, an oil of somewhat higher viscosity, i.e., 200 to 300 seconds Saybolt, will give more protective lubrication.

The purest grade of straight mineral oil obtainable should always be used in order that the above requirements will be adequately met. Oils of this nature will have a sufficient range of physical properties to lubricate compressors effectively under all normal conditions of operation. Animal and vegetable oils are not

suitable for such service inasmuch as they will have a tendency to congeal at low temperatures and gum at higher temperatures. They may also react to a certain extent with ammonia, to cause the formation of sludge.

The viscosity is especially important where enclosed crankcase, high speed machines of the wet compression type are involved. As a rule, oils should be used which will stand considerable churning in the presence of the refrigerant and a certain amount of water vapor. Here one oil lubricates the entire machine. As a result, it must be capable of serving both the cylinders and bearings. It should not emulsify to any great extent, for this might result in clogging of the lubricating lines, or impairment of refrigeration should it work past the piston rings and over to the refrigerating side of the system. From a mechanical point of view the seal and compression forming ability of an oil is practically as important as its lubricating properties.

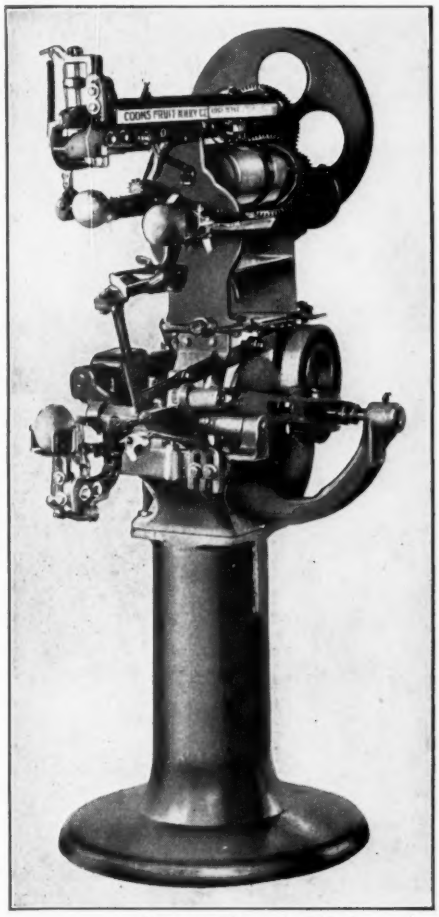
Higher viscosity oils should also be considered where cylinder walls and rings may be worn or scored. Usually an oil having a viscosity of 300 seconds Saybolt at 100 degrees Fahr., will be satisfactory in this event. Obviously, therefore, the physical condition of the valves, piston rings and stuffing boxes must always be considered in deciding upon the viscosity. There will be greater tendency for horizontal compressor cylinders to wear out of round than those of vertical machines. In consequence, such compressors may often require a fairly heavy lubricant. It is not advisable, however, to attempt to compensate for wear by increasing the viscosity too much on account of the possibility of reduction in cooling capacity due to emulsification or congealment.

PRESSURE LUBRICATED BEARINGS

Pressure lubrication for bearing protection has become virtually standard on certain types of canning machinery—notably those devices which are designed for fruit preparation. Machinery of this type has largely supplanted the more tedious methods of manual handling which include peeling, coring and slicing. In these operations a considerable amount of juice may be present; if it gets into bearings, especially if they are of the ball or roller type, it will normally be of such a nature chemically as to lead to corrosion, particularly if the lubricant is not capable of protecting the bearing elements against this reaction.

Grease lubrication by means of the pressure gun or some type of constant pressure fitting or lubricating fitting has been proved to be very effective in protecting virtually any type of bearing against the corrosive or abrasive effects of chemicals, water or other non-lubricating matter. The bearing, of course, must be designed for this type of lubrication for it is obvious that one could not apply grease to a ring-oiled job, or to a series of bearings equipped for oil circulation. Improvements in power transmission, machine design, and the perfection of the equipment employed for production purposes, however, in the modern cannery have taken all this into consideration.

In the beginning where pressure was concerned in connection with grease, it involved the compression grease cup. In many respects this device has proved to be a dependable means of lubrication, provided one could rely on machine operators to handle it intelligently.

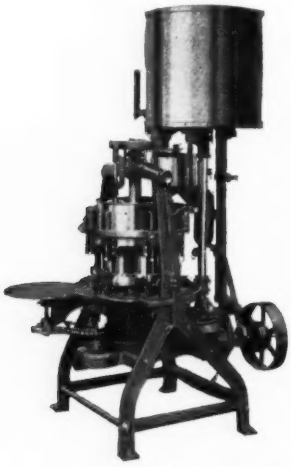


Courtesy of Coons Fruit Equipment Corporation

Fig. 10—An interesting type of machine adaptable to orange and lemon peeling. On this machine the Coons Fruit Equipment Corporation has given especial care to the study of lubrication in the interest of protecting all moving parts and enabling lubricants to function at their best.

To offset the advantages of simplicity and low cost, however, the limited capacity, the possibility of contamination of grease, the variable pressures involved, and the necessity for frequent attention have always been regarded as

disadvantages. With improvements in machine design there developed, therefore, a marked interest in the study of methods of pressure grease lubrication, and means to assure of more uniform maintenance of lubrication. In



Courtesy of Sprague-Sells Corporation

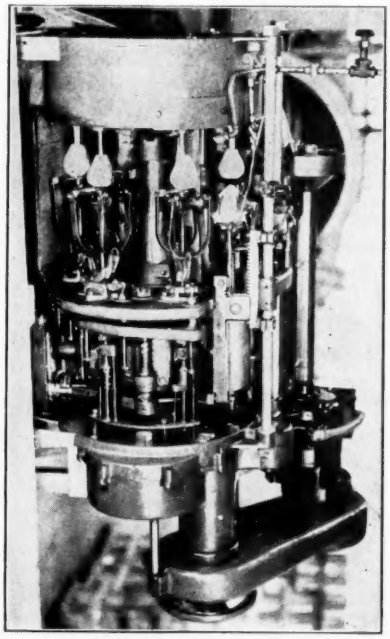
Fig. 11—Pre-heating (or cooking) and filling of corn, pumpkin, etc., can be effectively handled on a combined cooker-filler. On such a machine certain of the lubricants will, of course, be subjected to comparatively high temperatures, therefore considerable care is essential in their original selection.

the sleeve type bearing this is frequently a most necessary matter, where the grease at the exterior of the bearing must act as a seal to prevent entry of foreign matter.

The features of any such means of lubrication include positive delivery of the lubricant under adequate pressure to insure that a sufficient film of lubricant is constantly maintained in the clearance space of the sleeve type bearing, or on all moving parts of the ball or roller type; the least amount of labor for operation; exclusion of non-lubricating foreign matter; elimination of hazard when handling; and increased economy of lubricant.

As these features have been developed, means for handling heavy greases under considerable power have also been improved. This has been especially advantageous where it has been found to be practicable to lubricate a number of bearings from one central point of control. The conventional pressure grease gun has also been similarly improved. This device is of decided value as an all-round means of lubrication in the modern cannery, inasmuch as it can be used quite as effectively with individual lubricators as with a centralized system. It can, furthermore, be used with equal dependability in connection with the spring type grease cup. The latter is an excellent means of lubrication where bearings may be relatively inaccessible, and where personal hazard might be involved should frequent relubrication be necessary.

The spring type cup as designed for use with a pressure grease gun requires the application of a spring of particular tension along with a suitable orifice to enable steady flow of grease at as uniform a pressure as possible; accurate control of this flow is also practicable where all parts of the lubricating system have been studied with respect to each other. Filling of such a lubricator is a simple and clean matter: The pressure gun is attached to a suitable fitting located in the base of the cup and operated until the indicator which protrudes through the top of the cover rises to its full height. There is no necessity for removal of the cover, as with the old style of compression grease cup; consequently, there is more positive assurance that the grease will not become contaminated through possible entry of dust or dirt. Any conventional type of pressure gun can be used with such an installation, operated by compressed air, electric power or simply hand or foot power according to the consistency of the grease being used, the pressure desired and the type of gun.



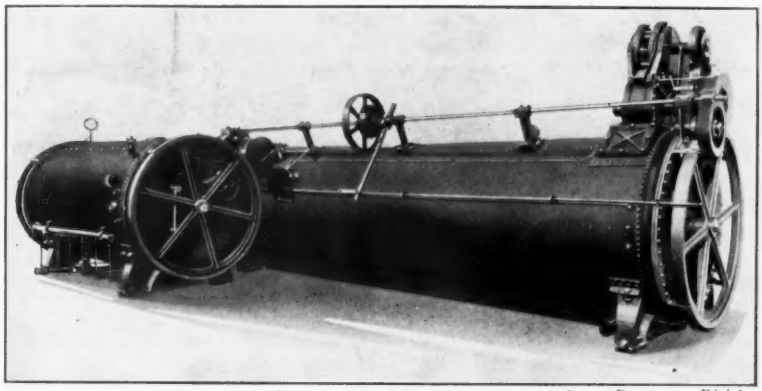
Courtesy of Food Machinery Corp.—Anderson-Barngrover Division

Fig. 12—Detailed view of an Anderson-Barngrover pear preparation machine showing the pears in actual course of handling. The exposed nature of the fruit renders it essential to be especially careful in the choice of lubricants which will not cause any food contamination. In turn, however, these lubricants and the moving parts of the machine must be effectively protected against the destructive effects of the fruit juices.

Use of the hand pressure gun with or without an auxiliary means of maintaining lubrication should not be confused in principle with the compression grease cup. To be true, pressure is manually applied, but where this is used in

conjunction with the spring type cup, hand pressure as applied to the gun does not react directly on the bearing; it must first do work by compressing the spring in the grease cup. From this point on the mechanical action of this spring against the plunger which is in direct contact with the grease charge, automatically maintains a constant discharge of grease through the orifice adjacent to the bearing. This type of lubrication is adaptable to the sleeve or plain bearing where a comparatively heavy lubricant is required to prevent leakage and entry of acids or other non-lubricating matter.

When higher pressures are necessary than can be developed with the hand gun, the power operated device should be used; such pressures will be advantageous when bearings are to be cleared of old grease. This is very often a beneficial procedure where sleeve-type bearings are concerned, although good judgment is necessary in deciding when a bearing has been completely cleared of old grease and re-filled with fresh product; otherwise waste will result and also a sloppy condition may develop around the machine which may be decidedly hazardous. Full and continued pressure, however, is only truly adapted to the sleeve-type bearing; if applied to the ball or roller bearing the seals may be impaired if too much grease is charged, especially as this type of bearing is in general more compactly built than the conventional plain bearing and, therefore, better capable of resisting entry of foreign matter. The pressure gun must also be carefully handled in connection with any ball or roller bearing, for control of lubrication is most important; as a rule, such a bearing should rarely be filled more than half full with grease, in the interest of minimum temperature rise and power consumption.



Courtesy of Food Machinery Corp.—Anderson-Barngrover Division

Fig. 13—Lubrication of the A-B Combined Pressure Cooker and Cooler has been carefully studied to the end that the mechanical force feed lubricator is now standard equipment on these machines. Tubes lead from this latter to each of the principal bearings, each oil feed being capable of individual adjustment to eliminate waste and the possibility of food contamination. In this machine the oil must not only be capable of functioning in the presence of high temperature, but it should also have a tendency to emulsify with water.

LUBRICATION OF SPECIALTY MACHINERY

Certain types of special duty machinery may often present specific conditions of design or operation which will require consideration apart from the broad treatment of bearings, gears, chains or cylinders. Among these will be the pear machine, the pitman shafts of some apple machines, the seamer rolls of closing and seaming machines and the internal bearings of the cooker and exhauster.

Pear Machines

The problem in lubricating the pear machine has centered about the choice of lubricants resistant to acid fruit juices, and capable of remaining on the moving parts to effectively prevent wear and corrosion. Considerable study has indicated the adaptability of a grease composed of an insoluble soap and an oil of approximately the viscosity of a heavy motor oil. The consistency of such a lubricant will enable ready handling in the pressure grease gun, and its durability and resistance to water wash will normally lengthen the period between re-lubrication.

Where reduction gears are employed for power transmission purposes the possibility of water and acid contamination must again be considered. Normal conditions in the type of gears and housings employed, would call for a straight mineral gear lubricant akin to that required for cold weather service in automotive operations. The presence of water, however, has led to serious consideration of the marine type of engine oil containing a sufficient amount of compound to develop an effective emulsion and form a lubricating film on the gear teeth which will be more resistant to the washing effects of water and protect all elements exposed to acid corrosion.

This same type of lubricant has also been found advantageous to use on the pitman shaft bearings of apple machines which likewise may be exposed to acid and water. On these elements, however, a somewhat heavier bodied product of steam cylinder oil nature has met with considerable success.

Closing and Seaming Machinery

Some of the most progressive developments in regard to protected lubrication have been

made on this class of machinery for all types of cannery operations. Circulating systems for lubrication of certain of the base parts have been applied, pressure grease lubrication for individual bearings has been adopted, and elsewhere the most important factor of prevention of food contamination has been considered by all the manufacturers.

Of the various parts requiring lubrication, the hot seamer roll has presented one of the most perplexing problems due to the necessity for planning on usage of a lubricant which will resist the thinning down effects of temperature, give proper lubrication, and so effectively remain in the lubricating system as to have the least possible tendency to creep and lead to food contamination. After considerable research work it is felt that a grease carrying a lubricating oil of considerable viscosity will normally be best suited to such mechanisms. Such a grease would in general be termed a high temperature lubricant by virtue of its high melting point and its ability to withstand heat. It has, furthermore, been proved to be highly resistant to oxidation and oil separation.

The top driving heads have also presented somewhat of a lubricating problem by virtue of the make-up of the gear set which will include a worm element combined with its respective gear along with a train of bevel and spur gears. Speed is not a factor in such a mechanism but leakage must be positively prevented, otherwise food contamination may result. Considerable thought, along with practical tests has been applied to this operation using a variety of grease combinations. Most recent work has indicated the adaptability of a comparatively fluid, high temperature grease, carrying a heavy viscosity oil which will effectively channel with the gear teeth and adequately prevent wear. The nature of such a grease is also conducive to minimum creeping and leakage.

The vacuum valves in certain types of vacuum seamers must also be carefully lubricated. One of the functions of the lubricant on these parts is to aid in maintenance of a very high vacuum in the interests of most positive operation. In selecting an oil for this service both the starting and operating viscosities must be considered. In other words the oil must be so fluid as to enable ready starting on a cold morning, and yet retain its body at the operating temperature so as to properly serve as a seal. Considerable practical research has developed that a specially refined straight mineral product ranging in the neighborhood of 75 to 80 seconds Saybolt viscosity at 210 degrees Fahr., will be most adaptable.

Cookers and Exhausters

The temperatures involved in equipment of this type and the moisture conditions which may frequently prevail impose quite a severe duty upon the lubricant which must serve the internal bearings. In cooker design oil lubrication is frequently essential, the machine being built for delivery of oil to each bearing through copper tubing extending thereto from the source of supply. For this type of operation a comparatively heavily compounded oil has been suggested by some authorities, the purpose of the compound being to aid in resisting water-wash by formation of an emulsion. At the same time the mineral base of the oil should have adequate body or viscosity to withstand the prevailing temperatures so that a lubricating film can be maintained which will give as positive protection as possible.

The vertical bearings or gear hubs of exhausters, on the other hand, will frequently be designed for grease lubrication. The operating temperatures will require the use of a high melting point, temperature resisting grease; the presence of moisture, in turn, must be met with an emulsifying characteristic. Above all, the grease must not show any separation of its oil and soap contents, and it must be highly resistant to oxidation and gum formation. To meet these requirements a specially compounded product of unusual heat-resisting qualities has been developed which will effectively resist water-wash and insure adequate protection of the bearings. It has proved remarkably stable under conditions which would cause an ordinary grease to break down and show marked reduction in lubricating ability.

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